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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
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THOMAS, KAYDEN, HOSTEMEYER & RISLEY LLP
100 GALLERIA PARKWAY
SUITE 1750
ATLANTA, GA 30339

EXAMINER	
PATEL, ISHWARBHAI B	

ART UNIT	PAPER NUMBER
2841	

DATE MAILED: 12/16/2005

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary	Application No.	Applicant(s)	
	10/781,169	LEE ET AL.	
	Examiner	Art Unit	
	Ishwar (I. B.) Patel	2841	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *05 December 2005*.

2a)☐ This action is **FINAL**. 2b)☒ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-18* is/are pending in the application.

4a) Of the above claim(s) *6 and 14* is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-5,7-13 and 15-18* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☒ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *18 February 2004* is/are: a)☐ accepted or b)☒ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☐ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☒ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) Paper No(s)/Mail Date *4/15/04*.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application (PTO-152)
6) ☐ Other: _____.

DETAILED ACTION

Election/Restrictions

1. Applicant's election without traverse of group I, claims 1-8, in the reply filed on December 5, 2005 is acknowledged.

Regarding specie election, specie I, claims 1-5, 7-13 and 15-18, are provisionally elected. Because applicant did not distinctly and specifically point out the supposed errors in the restriction requirement, the election of specie has been treated as an election without traverse (MPEP § 818.03(a)). Claims 1-5, 7-13 and 15-18 are examined on merit as follow. However, as indicated in the previous action, upon allowance of a generic claim, applicant will be entitled to consideration of claims to additional species which are written in dependent form or otherwise include all the limitations of an allowed generic claim as provided by 37 CFR 1.141.

Drawings

2. The drawings are objected to under 37 CFR 1.83(a). The drawings must show every feature of the invention specified in the claims. Therefore, (a) the metal trace structure is an X-shape, as claimed in claim 5, and (b) the metal structure including a channel, as claimed in claim 1 must be shown or the feature(s) canceled from the claim(s). No new matter should be entered.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended

replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

3. The drawings are objected to because the figures are improperly cross hatched. All of the parts shown in section, and only those parts, must be cross-hatched. The cross-hatching patterns should be selected from those shown on page 600-114/115 of the MPEP based on the material of the part. See also 37 CFR 1.84(h)(3) and MPEP § 608.02.

Corrected drawing sheets in compliance with 37 CFR 1.121(d) are required in reply to the Office action to avoid abandonment of the application. Any amended replacement drawing sheet should include all of the figures appearing on the immediate prior version of the sheet, even if only one figure is being amended. The figure or figure

number of an amended drawing should not be labeled as "amended." If a drawing figure is to be canceled, the appropriate figure must be removed from the replacement sheet, and where necessary, the remaining figures must be renumbered and appropriate changes made to the brief description of the several views of the drawings for consistency. Additional replacement sheets may be necessary to show the renumbering of the remaining figures. Each drawing sheet submitted after the filing date of an application must be labeled in the top margin as either "Replacement Sheet" or "New Sheet" pursuant to 37 CFR 1.121(d). If the changes are not accepted by the examiner, the applicant will be notified and informed of any required corrective action in the next Office action. The objection to the drawings will not be held in abeyance.

Specification

4. The abstract of the disclosure is objected to because of the inclusion of legal phraseology "comprising". Correction is required. See MPEP § 608.01(b).

5. The disclosure is objected to because of the following informalities: "the metal trace structure including a channel therein" as claimed in claim 1 and 11, is not disclosed in the specification. The specification must include a written description of the invention or discovery and of the manner and process of making and using the same, and is required to be in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which the invention or discovery appertains, or

with which it is most nearly connected, to make and use the same, see 37 CFR, 1.71 (a).

Appropriate correction is required.

Claim Rejections - 35 USC § 112

6. The following is a quotation of the second paragraph of 35 U.S.C. 112:

> The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

7. Claims 1-5, 7-13 and 15-18 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

Regarding claim 1 and 11, the recitation "the metal trace structure including a channel therein" is unclear. As the structure of the channel in the metal structure is not shown or described in the specification, the structure of the channel is indefinite.

Claims 2-5, 7-10, 12, 13 and 15-18 depend upon claims 1 and 11, and inherit the same deficiency.

For the examination purpose, it is assumed as space on the substrate for receiving the underfill.

Claim Rejections - 35 USC § 103

8. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and

the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

9. Claims 1, 2, 5, 7 and 8, as best under stood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Onodera et al., US Patent No. 6,600,217 (Onodera) in view of Iwasaki et al., US Patent No.6, 777,814 (Iwasaki).

Regarding claim 1, Onodera, in figure 1-3, discloses a substrate structure, comprising: a substrate (1a); a solder mask (6) formed over the substrate, channels (4) formed in the mask for the receipt of underfill, the channel further including a central portion (area of crossing of channel 4) with arms radiating outwardly therefrom, dividing the solder mask into separate areas (see figure 1). Onodera does not disclose a metal trace on the substrate.

Iwasaki, in figure 3 and 4, discloses a dummy metal area in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device, (column 1, line 60 to column 2, line 10 and column 2, line 51-56)

A person of ordinary skill in the art at the time of applicant's invention would have been motivated to provide a metal trace structure on the substrate in order to a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device. Also, it will be advisable to provide the dummy traces in the channels formed in the mask to be able to be in direct contact with underfill material for the better heat distribution.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide a metal trace structure in the channels formed on the surface of substrate of Onodera, as taught by Iwasaki, in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device.

Regarding claim 2, the modified circuit structure of Onodera further discloses the arms each include a distal end (see figure 1, distal end at the end of the channel).

Regarding claim 5, the modified circuit structure of Onodera further discloses the metal trace structure is an X-shape (see Onodera figure 1).

Regarding claim 7, the modified circuit structure of Onodera further discloses the arms each include a distal end wherein the distal ends of the respective arms receive the underfill (see Onodera figure 1).

Regarding claim 8, the modified circuit structure of Onodera further discloses the arms each include a T-shaped distal end wherein the T-shaped distal ends of the respective arms receive the underfill (see Onodera figure 1).

10. Claims 3 and 4, as best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over the modified substrate structure of Onodera as applied to claim 1 above, and further in view of Scholz, US Patent No. 5,329,423.

Regarding claim 3, the modified circuit structure of Onodera discloses all the features of the claimed invention but does not disclose solder bumps. Onodera discloses solder bump pads (2) formed on the substrate to be connected with the bump formed on the bump (11) on the semiconductor chip (10, figure 4C). Scholz, in figure 1 and 2, recites an interconnection structure and discloses that the solder bumps can be formed either on the chip or on the substrate depending upon the requirement. A person of ordinary skill in the art would have been motivated to provide the bumps on either of the surface depending upon the suitability of the manufacturing process to have lower cost.

Therefore it would have been obvious to a person of ordinary skill in the at the time of applicant's invention to provide the circuit structure of Onodera with the solder bumps formed on the solder pads, as taught by Scholz, in order to have desired electrical and mechanical connection of the chip with the substrate at lower cost.

Regarding claim 4, the modified circuit structure of Onodera further discloses the solder the solder mask includes a series of solder bumps not over the metal trace structure (see figure 1, Onodera).

11. Claims 9 and 10, as best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over the modified circuit structure of Onodera as applied to claim 1 above, and further in view of Lance, Jr. et al., US Patent No. 5,697,148 (Lance).

Regarding claim 9, the modified circuit structure of Onodera discloses all the features of the claimed invention as applied to claim 1 above, including the metal structure, but does not disclose the central portion of the metal trace structure includes a shaft in communication with the channel.

Lance, in figure 4, disclose a flip underfill injection technique with a hole (shaft) in the center of the substrate for the entry of the underfill to have a void free underfilling (column 3, line 9-12).

A person of ordinary skill in the art at the time of applicant's invention would have been motivated to provide a shaft (hole) in the center of the substrate surface in order to facilitate injecting underfill to have a void free underfill.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the circuit structure of Onodera with a shaft (hole), as taught by Lance, in order to facilitate injecting underfill to have a void free underfill.

Regarding claim 10, the modified circuit structure of Onodera discloses the central portion of the metal trace structure includes a shaft in communication with the channel wherein the shaft receives the underfill, as applied to claim 9 above.

12. Claims 11-13, 15 and 16, as best understood, are rejected under 35 U.S.C. 103(a) as being unpatentable over Onodera et al., US Patent No. 6,600,217 (Onodera) in view of Iwasaki et al., US Patent No.6, 777,814 (Iwasaki) and Scholz, US Patent No. 5,329,423.

Regarding claim 11, Onodera, in figure 1-3, discloses a substrate structure, comprising: a substrate (1a); a solder mask (6) formed over the substrate, channels (4) formed in the mask for the receipt of underfill, the channel further including a central portion (area of crossing of channel 4) with arms radiating outwardly therefrom, dividing the solder mask into separate areas (see figure 1). Onodera does not disclose a metal trace on the substrate and a series of solder bumps not over the metal trace structure.

Iwasaki, in figure 3 and 4, discloses a dummy metal area in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device, (column 1, line 60 to column 2, line 10 and column 2, line 51-56)

A person of ordinary skill in the art at the time of applicant's invention would have been motivated to provide a metal trace structure on the substrate in order to a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device. Also, it will be advisable to provide the dummy traces in the channels formed in the mask to be able to be in direct contact with underfill material for the better heat distribution.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide a metal trace structure in the channels formed on the surface of substrate of Onodera, as taught by Iwasaki, in order to have a uniform temperature distribution between the facing surfaces of the semiconductor chip and the substrate to have a better flow of the sealing resin (underfill) to have resultant enhanced reliability of the semiconductor device.

Regarding the solder bumps, Onodera discloses solder bump pads (2) formed on the substrate to be connected with the bump formed on the bump (11) on the semiconductor chip (10, figure 4C). Scholz, in figure 1 and 2, recites an interconnection structure and discloses that the solder bumps can be formed either on the chip or on the substrate depending upon the requirement. A person of ordinary skill in the art would have been motivated to provide the bumps on either of the surface depending upon the suitability of the manufacturing process to have lower cost.

Therefore it would have been obvious to a person of ordinary skill in the at the time of applicant's invention to provide the modified circuit structure of Onodera with the solder bumps formed on the solder pads, as taught by Scholz, in order to have desired electrical and mechanical connection of the chip with the substrate at lower cost

Regarding claim 12, the modified circuit structure of Onodera further discloses the arms each include a distal end (see figure 1, distal end at the end of the channel).

Regarding claim 13, the modified circuit structure of Onodera further discloses the metal trace structure is an X-shape (see Onodera figure 1).

Regarding claim 15, the modified circuit structure of Onodera further discloses the arms each include a distal end wherein the distal ends of the respective arms receive the underfill (see Onodera figure 1).

Regarding claim 16, the modified circuit structure of Onodera further discloses the arms each include a T-shaped distal end wherein the T-shaped distal ends of the respective arms receive the underfill (see Onodera figure 1).

13. Claims 17 and 18 are rejected under 35 U.S.C. 103(a) as being unpatentable over the modified circuit structure of Onodera, as applied to claim 11 above, and further in view of Lance, Jr. et al., US Patent No. 5,697,148 (Lance).

Regarding claim 17, the modified circuit structure of Onodera discloses all the features of the claimed invention as applied to claim 1 above, including the metal structure, but does not disclose the central portion of the metal trace structure includes a shaft in communication with the channel.

Lance, in figure 4, disclose a flip underfill injection technique with a hole (shaft) in the center of the substrate for the entry of the underfill to have a void free underfilling (column 3, line 9-12).

A person of ordinary skill in the art at the time of applicant's invention would have been motivated to provide a shaft (hole) in the center of the substrate surface in order to facilitate injecting underfill to have a void free underfill.

Therefore, it would have been obvious to a person of ordinary skill in the art at the time of applicant's invention to provide the circuit structure of Onodera with a shaft (hole), as taught by Lance, in order to facilitate injecting underfill to have a void free underfill.

Regarding claim 18, the modified circuit structure of Onodera discloses the central portion of the metal trace structure includes a shaft in communication with the channel wherein the shaft receives the underfill, as applied to claim 17 above.

Conclusion

14. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Greenwood et al., US Patent No. 5,647,123, in figure 3 and 4, discloses a structure with circuit board (310) having opening in solder mask (308) to have enough space between the circuit board and the chip to have better flow of underfill material.

Tsai et al., US Patent No. 6,772,512, in figure 2F, disclose a flip chip package with a shaft (hole 211) in the substrate (210).

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Ishwar (I. B.) Patel whose telephone number is (571) 272 1933. The examiner can normally be reached on M-F (8:30 - 5:00).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Kamand Cuneo can be reached on (571) 272 1957. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Ishwar (I. B.) Patel
Examiner
Art Unit: 2841
December 12, 2005